PATENT SPECIFICATION (11) 1248843

1248843

DRAWINGS ATTACHED

(21) Application No. 33537/69 (22) Filed 3 July 1969

(31) Convention Application No. A 7133 (32) Filed 23 July 1968 in

(33) Austria (OE)

(45) Complete Specification published 6 Oct. 1971

(51) International Classification H 03 f 1/00 H 02 m 3/32//H 03 b 5/12

(52) Index at acceptance

H3T 1A1 1G1 1G3X 2A1N 2A1S 2J 2L 2T3F 2T3J 2W2 2W3 2X 3K 3X 4A2 4A3 4B 4D 4E2N 4F 4G 4M 5P 5X

H2F 3E

H4J 24A1B

(54) A PREAMPLIFIER FOR A CAPACITIVE TRANSDUCER

(71) We, AKUSTISCHE U. KINO-GERATE GESELLSCHAFT m.b.H., an Austrian Company, of Nobilegasse 50, 1150 Vienna XV, Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a transistorized preamplifier assembly for a capacitive transducer.

The advantage afforded by transistorized preamplifiers in general compared to valve amplifiers resides mainly in the low power input which they require. The low voltages which are generally employed with transistors enable the preamplifier to be operated with a voltage applied from the succeeding main amplifier so there is no need for a mains-operated power supply such as is used for valve amplifiers. The fact that the filament circuit is eliminated and the supply voltage required is low enables the use of simplified supply circuitry whereby, e.g., in arrangements in which a two-wire cable is used between the preamplifier and main amplifier the d.c. voltage required to operate the preamplifier is supplied directly from the main amplifier in a phantom circuit which includes the two wires of the cable and the shield thereof. If a three-wire cable is used, the third wire of the cable rather than the shield can be used as a return conductor.

In such an arrangement including a capacitive transducer, the transducer can be operated if a cable connection is established between the microphone and the subsequent main amplifier, just as in the case of a dynamic microphone. Although the supply voltage is applied through the two sound wires, a dynamic microphone can be directly connected to the same plug receptacle without disturbing the function thereof. When the previously usual preamplifiers for condenser microphones were used, the polarity of the supply voltage had to be checked before these preamplifiers were connected to the main amplifiers. A check was required in each case to determine whether the supply voltage applied from the main amplifier to the preamplifier had the correct polarity. For this purpose, a studio technician, who may have to attend to a large number of amplifiers, must be exactly aware of the circuit arrangement of each amplifier and any error which may occur may result in a destruction of parts of the preamplifier. The polarity cannot be standardized because the use of different types of transistors (n-p-n, p-n-p) requires the use of amplifiers having a grounded negative terminal and of amplifiers having a grounded positive terminal.

For this reason, preamplifiers of two polarity types must also be available so that an error may result in a connection between two amplifiers which do not match.

A further drawback of known arrangements is that the voltage available for the preamplifier is limited by the magnitude of the supply voltage. This is especially important when the preamplifier is associated with a condenser microphone requiring a transducer-polarizing voltage which is a multiple of the voltage required for the operation of the preamplifier and which must be supplied by a separate source in known arrangements. This involves further complications.

According to the present invention, there is provided a transistorized preamplifier assembly for a capacitive transducer, including a voltage converter for connection to a d.c. voltage supply, which converter is connected to deliver to the transistorized preamplifier and to the capacitive transducer respective d.c. operating voltages having a polarity independent of the polarity of the d.c. voltage supply, the voltage converter including an oscillator circuit in which two transistors of opposite conductivity type are connected in parallel and being capable of providing oper-

ating voltages having a magnitude different from that of the d.c. voltage supply.

By employing the present invention a pre-amplifier can be arranged so that it is independent of the polarity of the supply voltage without need for changes in the circuitry of the amplifier proper. This fact results in advantages regarding the reliability of operation, the noise level and the circuit expenditure, the desired independence being ensured by the provision of the d.c. voltage to d.c. voltage converter.

The transistors of the oscillator circuit of the d.c. converter should be as similar as possible in their transmitting properties and frequency response and particularly as regards the breakthrough voltage so that a satisfactory function of the d.c. voltage converter is ensured regardless of the polarity of its supply voltage. Depending on the polarity of the supply voltage, one or other of the transistors of the oscillator circuit will conduct. In one form of the invention an inductive element of the oscillator circuit is constituted by the secondary winding of a transformer which has a centre tap, and one end of said winding and the centre tap thereof are connected to the inputs of mutually independent rectifier circuits.

Because the polarity is incorrect for the transistor which is inoperative, such transistor will be virtually blocked and carry only a very small current. This transistor is virtually no load on the other transistor and does not substantially influence the oscillation behaviour thereof.

The preamplifier may suitably include a field effect transistor.

Assuming an efficiency of 25%, a usual supply voltage of 12 volts for a field effect transistor amplifier and a current consumption of 0.5 milliamperes, the total current input of the circuit will be about 2 milliamperes. The main amplifier is usually capable of supplying direct current up to 10 milliamperes so that a satisfactory operation is ensured when the assembly is supplied with power from the main amplifier via a phantom circuit.

The invention will now be explained more fully with reference to the single figure of the drawing, which represents a basic circuit diagram of a preamplifier assembly embodying the invention.

The preamplifier proper is represented by that part of the circuit arrangement which is within the dashed lines. A condenser microphone M comprises two electrodes, one of which is connected to earth and the other of which is connected firstly by a resistor R_v to a polarizing voltage source and secondly, for alternating current, by the capacitor C_k to the gate electrode of a field effect transistor T_3. The latter operates as an impedance transformer and has a low-resistance output, which is connected to the primary winding of a transformer T, the secondary winding of which has a centre tap. In cable wires a, b leading from the preamplifier to the main amplifier, the supply current I_{sp} flows in the same direction to the preamplifier, in which the centre tap of the secondary winding of the transformer T is connected to the terminal $\pm U_B$.

A d.c. voltage converter of the assembly is fed through the latter terminal and consists essentially of an oscillator circuit comprising a transformer U having a secondary winding connected in parallel with a capacitor C, an n-p-n transistor T_2 and a p-n-p transistor T_1 in parallel, a feedback capacitor C_{rk} and a resistor R for applying the base voltage to the transistors. These parts of the circuit are shown on the left of the dash-dot line. On the right of that line, two rectifier circuits G_1, G_2 are shown, and these consist of half-wave rectifiers as usual. Special means for filtering the rectified voltages are neither required nor provided because the frequency of the converter may be so high, e.g., 1 Megacycle, that the filtering afforded by resistor R_v and the capacitance of the capsule of the condenser microphone M, or by resistor R_s and capacitor C_s, is sufficient.

In the practical dimensioning of the d.c. voltage converter, care should be taken that the breakthrough voltages of the diode paths of the two transistors T_1, T_2 cannot be exceeded. This requirement requires primarily a suitable selection of the two transistors. Because the operating voltage is generally 12 volts, it will be suitable to select transistors having a breakdown voltage which is reliably at least twice that value.

The polarities of the supply voltage for the pre-amplifier and of the polarizing voltage are determined only by the forward direction of the rectifier diodes D_1, D_2. This affords the advantage that the requirement for in-phase operation, i.e., that a positive acoustic impulse on the diaphragm of the condenser microphone M will result in a positive electric pulse, will always be met regardless of the polarity of the supply voltage.

Because only small components are used, the pre-amplifier and the voltage converter may be combined in a unit, which is supplied with power by a phantom circuit including the sound wires and the cable shield. The pre-amplifier, voltage converter and condenser microphone may be combined in a unit, e.g., by accommodating the preamplifier and voltage converter in the microphone housing. Such a condenser microphone unit would have properties similar to those of a low-resistance dynamic microphone.

WHAT WE CLAIM IS:—

1. A transistorized preamplifier assembly for a capacitive transducer, including a voltage converter for connection to a d.c. voltage supply, which converter is connected to deliver to the transistorized preamplifier and to the capacitive transducer respective d.c. operating voltages having a polarity independent of the polarity of the d.c. voltage supply, the voltage converter including an oscillator circuit in which two transistors of opposite conductivity type are connected in parallel and being capable of providing operating voltages having a magnitude different from that of the d.c. voltage supply.

2. An assembly according to claim 1, in which the voltage converter includes a transformer receiving the output of the oscillator circuit and having a centre-tapped secondary winding, the centre tap of the secondary winding being connected to a rectifier circuit arranged to deliver the respectiver d.c. operating voltage to the preamplifier and one end of the secondary winding being connected to another rectifier circuit arranged to deliver the respective d.c. operating voltage to the transducer.

3. An assembly according to claim 1 or 2, in which the preamplifier includes a field effect transistor.

4. A transistorized preamplifier assembly substantially as hereinbefore described with reference to and as illustrated in, the accompanying drawing.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1248843 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*